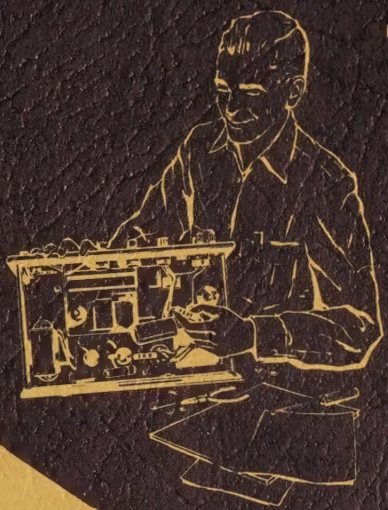
PRICE $1.00



Assembling
and Using Your...

3687 3687

Heathkit

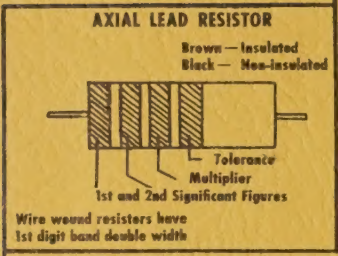
A. C. VOLTMETER

MODEL AV-2

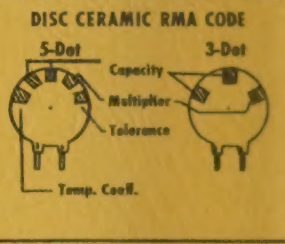
HEATH COMPANY
A Subsidiary of Daystrom Inc.
BENTON HARBOR, MICHIGAN

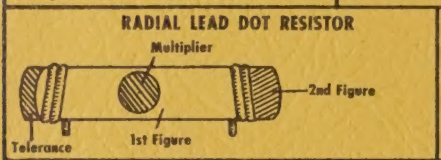
595-33

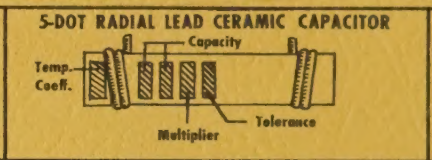
STANDARD COLOR CODE — RESISTORS AND CAPACITORS

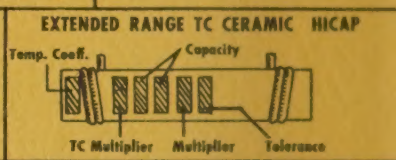


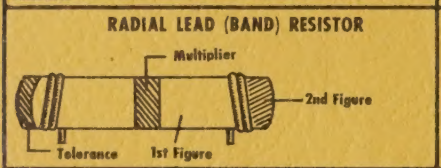
INSULATED UNINSULATED Color	FIRST RING BODY COLOR First Figure	SECOND RING END COLOR Second Figure	THIRD RING DOT COLOR Multiplier
BLACK	0	0	None
BROWN	1	1	0
RED	2	2	00
ORANGE	3	3	,000
YELLOW	4	4	0,000
GREEN	5	5	00,000
BLUE	6	6	000,000
VIOLET	7	7	0,000,000
GRAY	8	8	00,000,000
WHITE	9	9	000,000,000

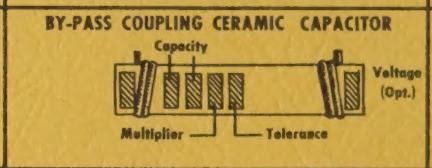


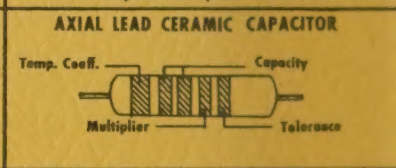








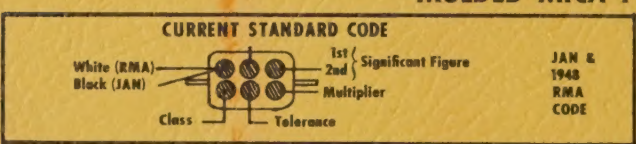


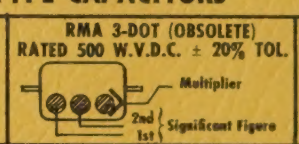


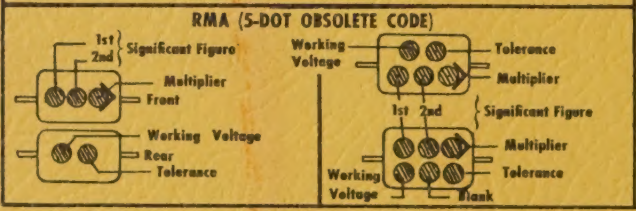
The standard color code provides all necessary information required to properly identify color coded resistors and capacitors. Refer to the color code for numerical values and the zeroes or multipliers assigned to the colors used. A fourth color band on resistors determines tolerance rating as follows: Gold = 5%, silver = 10%. Absence of the fourth band indicates a 20% tolerance rating.

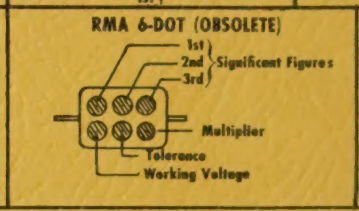
The physical size of carbon resistors is determined by their wattage rating. Carbon resistors most commonly used in Heathkits are ½ watt. Higher wattage rated resistors when specified are progressively larger in physical size. Small wire wound resistors ½ watt, 1 or 2 watt may be color coded but the first band will be double width.

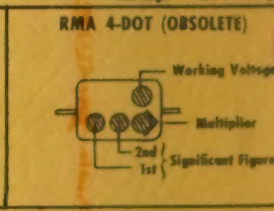
MOLDED MICA TYPE CAPACITORS



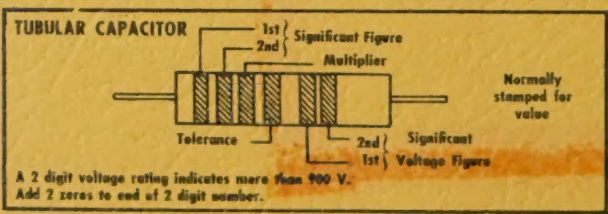


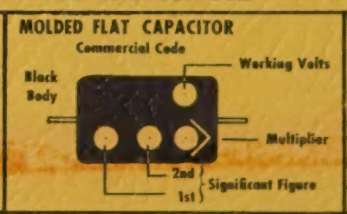


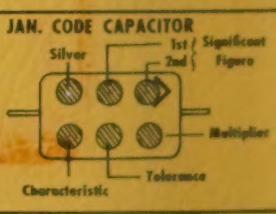




MOLDED PAPER TYPE CAPACITORS







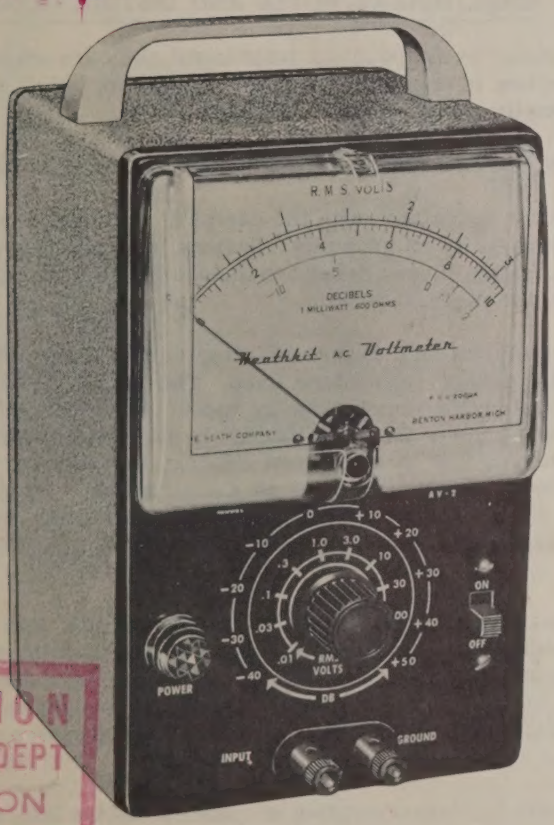
The tolerance rating of capacitors is determined by the color code. For example: red = 2%, green = 5%, etc. The voltage rating of capacitors is obtained by multiplying the color value by 100. For example: orange = 3 × 100 or 300 volts. Blue = 6 × 100 or 600 volts.

In the design of Heathkits, the temperature coefficient of ceramic or mica capacitors is not generally a critical factor and therefore Heathkit manuals avoid reference to temperature coefficient specifications.

Courtesy of Centralab

HEATHKIT
MODEL AV-2
A. C. VOLTMETER

THIS IS BOOK NO. 1



Book#1

3687
#3687

AINING SECTION
USTRIAL RELATIONS DEPT
ERO-SPACE DIVISION

Technical Specifications

Power Requirement:	105-125V AC, 50-60 cycles, 10 Watts
Tube Complement:	1 - 6AU6 1 - 6AT6
Input Impedance:	1 Megohm at 1 KC
Ranges:	.01, .03, .1, .3, 1, 3, 10, 30, 100, 300 V RMS
Decibels:	Total range -52 to +52 db, scale -12 to +2 db. (1 MW - 600 ohm) ten switch selected ranges from -40 to +50 db.
Physical Specifications:	7-3/8" high x 4-11/16" wide x 4-1/8" deep
Net Weight 3½ lbs.	Shipping Weight 5 lbs.

ASSEMBLY AND USE OF THE HEATHKIT
MODEL AV-2
A. C. VOLTMETER

PRELIMINARY NOTES AND INSTRUCTIONS:

Your Heathkit A.C. voltmeter is an excellent instrument and care used in its construction will be well repaid. Construction is open and easily accomplished, but it should not be rushed, as poor workmanship can easily result in poor operation.

UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST.

In so doing, you will become acquainted with the parts. If a shortage is found, attach the inspection slip to your claim, and notify us promptly. Screws, nuts, and washers are counted mechanically, and if a few are missing, please secure them locally. Use the charts on the inside covers of this manual to identify the parts.

Read the manual completely through before starting actual construction; in this way, you will become familiar with the general procedure used. The model AV-2 is a more advanced type kit. Its construction should not be undertaken by those inexperienced in the construction and operation of laboratory equipment. Because this kit is not intended for the novice; the very detailed "step-by-step" construction" found in most Heathkit manuals has been omitted. In its place there has been added a section entitled "Notes on Construction." This more generalized construction procedure will be less tedious and much more interesting for the more experienced builder. When actually assembling, read each article completely through so that no suggestion will be missed.

Small changes in parts may be made by the Heath Company. Any part supplied will work just as well as the part for which it was substituted. By reading the color code on resistors for instance, it will be readily understood that a value of 5100 ohms is a substitute for the specified 4700 ohms, provided the specified value is not supplied. Such changes will only be made if the specified parts are unobtainable at the time, and are made to insure a minimum delay in filling your order.

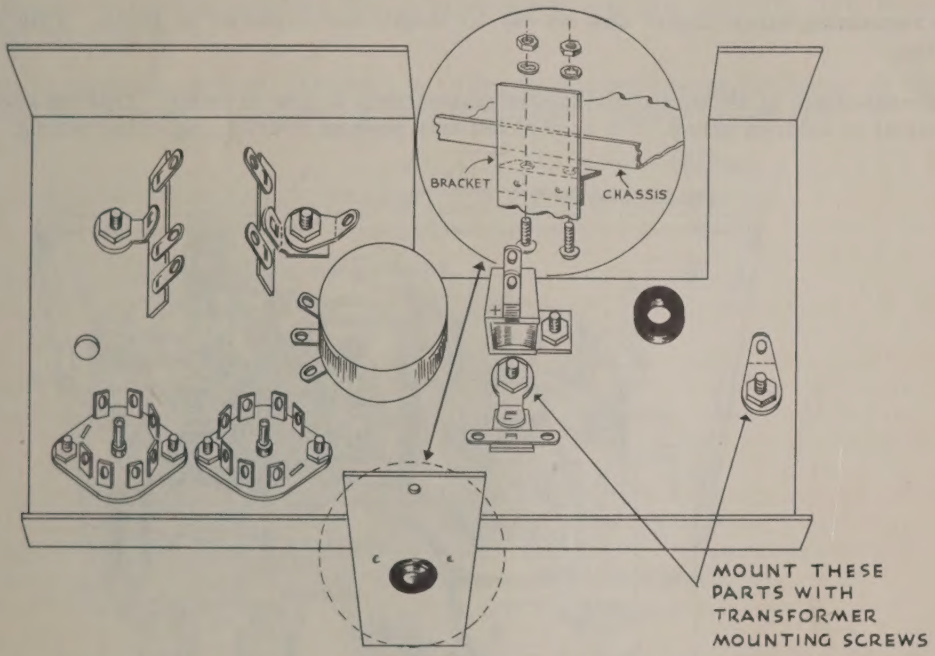
Resistors and controls have a tolerance rating of plus or minus 20% unless otherwise stated. Therefore, a 100K ohm resistor may test between 80K and 120K ohms. The letter K stands for 1,000 and M for 1,000,000. Thus a resistor marked 90K is 90,000 ohms etc. Some manufacturers use M for 1,000. Consulting the parts list will clarify any parts in question. Frequently condensers show even greater variations such as minus 50% to plus 100%. This Heathkit is designed to accommodate such variations.

NOTES ON CONSTRUCTION

Many tests were run to determine the best chassis layout before the final instrument was approved. We therefore strongly recommend that the photoprint and pictorials be followed exactly when building the kit. Any deviations from the actual model may produce unwarranted inaccuracies in the completed instrument.

ASSEMBLY:
To begin construction, mount the tube sockets, calibration control, selenium rectifier, two lug and three lug terminal strips, and the rubber grommets as shown in Figure 1 below. Use lockwashers under all hardware, and between the control bushing and the chassis.

Pass the red and yellow pairs on the transformer through the grommet and mount to chassis. Use these mounting screws to secure the line cord terminal strip above the chassis, and the #6 solder lug below the chassis. (See figures 1 and 2)



PARTS LAYOUT (BOTTOM CHASSIS)

(FIGURE 1)

WIRING:

Wiring of the chassis may now be completed according to the pictorial wiring diagram. Leave all leads which go from chassis to panel sufficiently long. Utilizing the chassis wiring photo-print will help in getting the parts in their exact places. Many parts are supplied by the manufacturer with leads far too long for a compact instrument such as this. These leads should be cut to proper length as the parts are wired into place. Not only will this produce a neater looking instrument, but in highly sensitive circuits, long leads may cause erratic operation. Proper polarity must be observed on such items as electrolytic condensers, selenium rectifiers, and crystal diodes.

NOTE: ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE INSTRUMENTS IN WHICH ACID CORE SOLDER OR PASTES HAVE BEEN USED. (When in doubt about solder, it is recommended that a new roll plainly marked "Rosin Core Radio Solder" be purchased.)

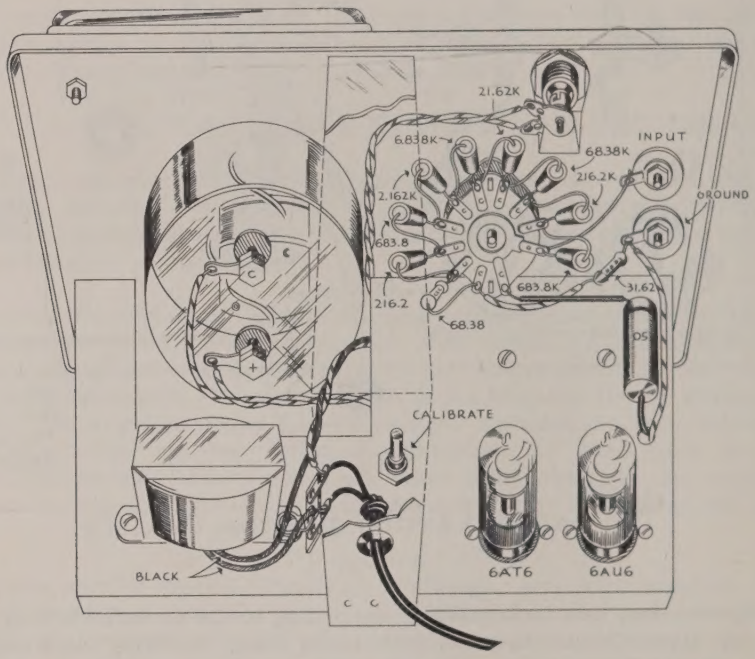
Having completed the chassis wiring, the next step is the mounting of the precision resistors on the range selector switch. Follow Figure 2 and the switch detail very carefully.

Next mount the completed range switch on the panel. Add the pilot light and input terminal assemblies. Note the small detail drawings for proper assembly. DO NOT mount the meter or power switch yet.

Attach the panel to the chassis, using the power switch hardware. Mount chassis bracket as shown in Figure 1. Then mount the meter, using two of the meter mounting bolts to secure the panel to the chassis and chassis bracket.

The remaining wires should now be cut to length and soldered in place. This completes the wiring.

A careful check of all wiring and solder connections is now in order. Tracing each lead on the pictorial in colored pencil as it is checked may prevent overlooking some wiring.



TOP CHASSIS PICTORIAL
(FIGURE 2)

IMPORTANT WARNING

Miniature tubes can be easily damaged when plugging them into their sockets. This is especially true if small quantities of solder have been allowed to lodge in the socket pin holes. Therefore, use extreme care when installing these tubes. WE DO NOT GUARANTEE OR REPLACE MINIATURE TUBES BROKEN DURING INSTALLATION.

After the wiring has been checked, the tubes can be placed in their respective sockets and the instrument is ready for testing and calibration.

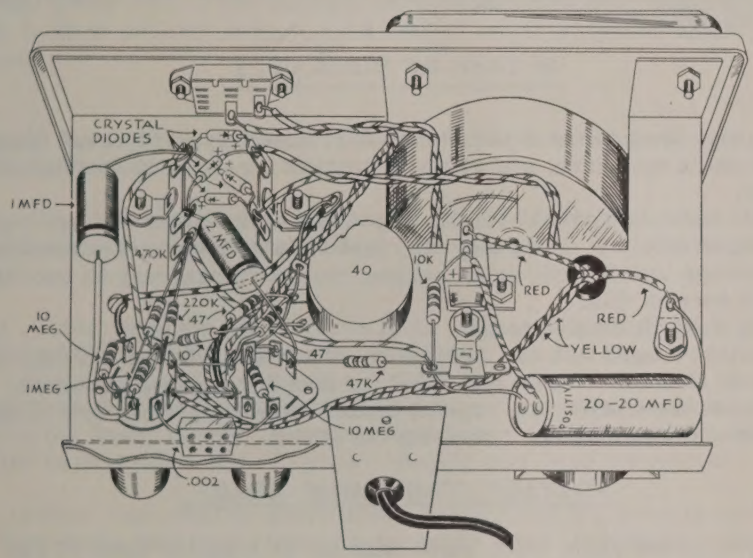
TEST AND CALIBRATION

With the instrument turned off, make sure the mechanical zero of the meter is correct. If not, adjust as follows: Place instrument in normal operating position. (i.e. such as it would be, if set on a level surface when mounted in its cabinet.) Turn the black plastic screw on the meter face with a screwdriver, while gently tapping the meter face with one finger, until the pointer coincides with the zero line on the left side of the scale.

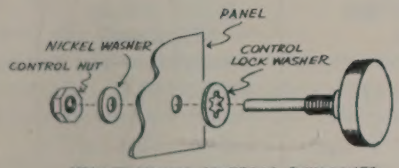
Plug into a 117 volt 50/60 cycle AC outlet. SERIOUS DAMAGE will result if an attempt is made to operate this instrument on DC.

Upon turning on the switch, the pointer should move about slightly. Allow the unit a minute or so to warm up. With the meter range switch set to the 300 volt range, connect the input terminals to the 117V AC line. Adjust the calibration control until the meter reads 117V on the 300V range. Power companies maintain line voltages within approximately 5%. This is sufficiently accurate for most uses.

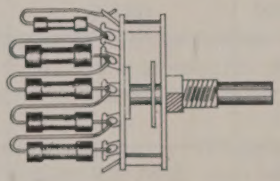
If any difficulty is experienced when attempting to calibrate the instrument, the power should be disconnected and the steps outlined under "In Case of Difficulty" should be followed.



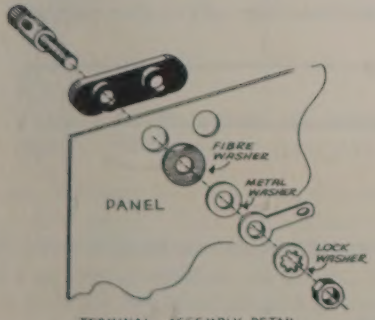
BOTTOM CHASSIS PICTORIAL
(FIGURE 3)



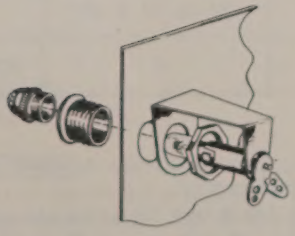
HOW TO MOUNT CONTROLS & SWITCHES



MOUNT RESISTORS AS SHOWN



TERMINAL ASSEMBLY DETAIL



PILOT LIGHT ASSEMBLY

When a standard AC voltmeter is available, a more accurate calibration may be made. If possible, make adjustments nearer full scale, such as 90V on the 100V range or 250V on the 300V range.

After calibration, install the instrument in the cabinet with two sheet metal screws through the back panel and into the chassis. This completes the instrument.
NOTE: When comparing this instrument with another instrument, consider that the instruments may deviate in opposite directions. Thus two instruments, both accurate to 2%, may show a difference in reading of 4%. Critical comparison should be made only against an accurate laboratory standard AC voltmeter.

IN CASE OF DIFFICULTY

1. Recheck the wiring. Most cases of trouble result from wrong or reversed connections. (Often having a friend check the wiring will reveal a mistake consistently overlooked.)
2. Check the tubes.
3. The 1 and 2 mfd. metallized condensers are specially selected for the application. DO NOT USE ordinary paper tubulars, since they may lead to instability or inaccuracies.
4. If the pointer swings to full scale on all ranges, the instrument may be oscillating. Redress of wiring should correct this.
5. Check continuity through the test leads.
6. Compare operating voltages with the table below. If a wide deviation is found, the transformer and filter circuits should be rechecked. Test for possible component failure.
7. If the meter reads downscale, the crystal diodes have been reversed. Correct by interchanging the meter connections or reversing the diodes.

VOLTAGE COMPARISON CHART

Measurements shown in the chart were made with an 11 megohm input VTVM. Each voltage reading was made with respect to the chassis.

PIN	6AU6	6AT6	RECTIFIER LUG	RECTIFIER VOLTAGE
1	0 to - 1 V DC	0 to - 1 V DC	To Filter	140 to 180 V DC
2	0	0	To Power Trans.	115 to 145 V AC
3	3 to 4 V AC	3 to 4 V AC		
4	3 to 4 V AC	3 to 4 V AC		
5	20 to 26 V DC	0		
6	28 to 38 V DC	0		
7	0	90 to 100 V DC		

USING THE INSTRUMENT

Reading Voltages:
The Model AV-2 has 10 separate voltage ranges allowing measurements up to 300 volts RMS. Frequency response is ± 1 db from 10 CPS to 50 KC.

15cps

The markings on the range switch refer to full scale readings.

When the instrument is set to the lower ranges the meter will show a residual indication. This is caused by the extreme sensitivity of the circuit. To check for zero indication, the input terminals should be shorted together. This residual indication has no effect on the accuracy of these ranges when readings are made across low impedance circuits.

Residual indication can be reduced by connecting the grounded input terminal to a good outside ground. Also some reduction may be noted by setting the range switch to the lowest range and reversing the line plug in its receptacle, noting which way gives the lower residual indication.

The meter scale is marked 0-3 and 0-10 for voltage measurements. When making measurements on the .03, .3, 3, 30 or 300 volt ranges, read the 0-3 meter scale and adjust the decimal for the correct voltage.

Example—

Using the .03 range, the meter reads (2.). For correct voltage, move the decimal two places to the left, (.02) volts.

When making measurements on the .01, .1, 1, 10, or 100 volt ranges, read the 0-10 meter range and adjust the decimal for the correct voltage.

Example—

Using the .1 volt range the meter reads (6.4). For correct voltage move the decimal two places to the left, or (.064) volts.

Due to the high sensitivity of the instrument, the input terminals should not be touched when the meter is set for the lower ranges. Stray electric fields, picked up by the human body will deflect the pointer beyond full scale. Repeated banging may bend the pointer.

Although the pointer may bend by overloading, the electronic circuit is self limiting. Because of this self limiting the maximum current through the meter movement under extreme overload conditions is yet within the safety factor of the meter coil windings. Although the meter may not burn out from severe overloading, other circuit components can be damaged by prolonged overloads.

Using the Decibel Scale:

Because the human ear does not respond to the volume of sound in proportion to the signal strength, a unit of measure called the "Bel" was adopted. The "Bel" is more nearly equivalent to human ratios. Normally the reading is given in 1/10 of a "Bel" or "decibel."

Different signal levels are adopted by various manufacturers as standard or "O" decibels. The trend within the last few years has been toward the use of 1 milliwatt into a 600 ohm load as "O" db. This reference has been given a special designation of "dbm." This Heathkit is calibrated to read in "dbm" when connected across a 600 ohm load.

When using the AV-2 for db measurements, adjust the range switch until there is a reading on the decibel scale. The meter reading is then either added to or subtracted from the range indication.

Example—

Range + 20 db, meter indicates -5 db, actual value is +15 db.
Range -10 db, meter indicates -4 db, actual value is -14 db.

As the decibel is a power ratio or voltage ratio, it may be used as such without specifying the reference level. Thus for instance, a fidelity curve may be run on an amplifier by feeding in a signal of variable frequency but constant amplitude. At a reference frequency of say 400 cycles, make an initial reading on the AC voltmeter, connected to the output. A suitable load, such as a speaker or resistor should be connected to the amplifier output during the test. As the input frequency is varied, amplitude held constant, the output level variation may be noted directly in db above and below the specified reference level.

When making comparative measurements, the circuit impedances must be considered. Such is the case when measuring overall gain through an amplifier. If the input impedance is the same as the output impedance, the db gain can be measured directly with the AV-2 In the case where the input and output impedance differ, it is necessary to correct each reading mathematically to a common reference level.

COMPLEX WAVE FORMS

This instrument, like most AC voltmeters, is calibrated to read the Root Mean Square (RMS) value of a pure sine wave. This is 70.7% of the peak voltage.

As characteristic of most rectifier type instruments, the meter deflection is proportional to the average value of the input wave form. Thus when measuring odd shaped waves (square, saw-tooth, pulse) the meter reading must be given special interpretation. Special reading on this subject will be found in the bibliography.

CIRCUIT DESCRIPTION

The basic circuit consists of two stages of amplification feeding a modified bridge circuit. The meter-bridge circuit returns to the cathode of the voltage amplifier to provide negative feed-back.

The AC voltage to be measured is applied across a one megohm voltage divider. This voltage divider provides ten separate meter ranges. The precision resistors used here make it possible for one calibration to serve all ten ranges. Part of the voltage developed across the divider is applied to the grid of the first amplifier stage.

The first stage of amplification uses a hi-gain pentode as a voltage amplifier. The next stage utilizes a hi-mu triode as a current amplifier to feed the meter circuit. Within the modified bridge circuit, the two crystal diodes rectify the output current, providing an unidirectional current flow through the meter movement.

Feedback from the plate of the last stage is applied to the cathode of the input stage. By varying the calibration control, which is in the ground return of this cathode, the feedback is changed thus controlling the overall gain of the amplifier.

The use of feedback in this fashion provides a high degree of stability to the instrument, and greatly extends its frequency response. Further discussion of this circuit is beyond the scope of this manual and interested persons are again referred to the bibliography. These articles present a most complete discussion of the characteristics.

The power supply is transformer operated, with a simple half-wave rectifier and resistance-capacity filter system.

ACCURACY

The accuracy of the meter movement is within 2% of full scale. The precision resistors used in the voltage divider are held to within 1%. Some slight error may be introduced by the circuit itself. Final accuracy of the instrument should be within 5% of full scale at the calibrating frequency.

The frequency response of the instrument is $\pm$ 1 db from 10 CPS to 50 KC.

In actual practice, inaccuracies do not usually fall in the same direction, consequently some tend to cancel out others. Therefore, it should be expected that the accuracy of the AV-2 will fall well within 5% of full scale.

REPLACEMENTS

Material supplied with Heathkits has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally improper instrument operation can be traced to a faulty tube or component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information:

A. Thoroughly identify the part in question by using the part number and description found in the manual parts list.
B. Identify the type and model number of kit in which it is used.
C. Mention the order number and date of purchase.
D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. Please do not return the original component until specifically requested to do so. Do not dismantle the component in question as this will void the guarantee. If tubes are to be returned, pack them carefully to prevent breakage in shipment as broken tubes are not eligible for replacement. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SERVICE

In event continued operational difficulties of the completed instrument are experienced, the facilities of the Heath Company Service Department are at your disposal. Your instrument may be returned for inspection and repair for a service charge of $3.00 plus the cost of any additional material that may be required. THIS SERVICE POLICY APPLIES ONLY TO COMPLETED INSTRUMENTS CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Instruments that are not entirely completed or instruments that are modified in design will not be accepted for repair. Instruments showing evidence of acid core solder or paste fluxes will be returned not repaired.

The Heath Company is willing to offer its full cooperation to assist you in obtaining the proper operation of your instrument and therefore this factory repair service is available for a period of one year from the date of purchase.

SHIPPING INSTRUCTIONS

Before returning a unit for service, be sure that all parts are securely mounted. Attach a tag to the instrument giving name, address and trouble experienced. Pack in a rugged container, preferably wood, using at least three inches of shredded newspaper or excelsior on all sides. DO NOT SHIP IN THE ORIGINAL KIT CARTON AS THIS CARTON IS NOT CONSIDERED ADEQUATE FOR SAFE SHIPMENT OF THE COMPLETED INSTRUMENT. Ship by prepaid express if possible. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damage in transit if packing, in HIS OPINION, is insufficient.

SPECIFICATIONS

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

WARRANTY

The Heath Company limits its warranty of parts supplied with any kit to a period of three (3) months from the date of purchase. Replacement will be made only when said part is returned postpaid, with prior permission and in the judgment of the Heath Company was defective at the

time of sale. This warranty does not extend to any Heathkits which have been subjected to misuse, neglect, accident and improper installation or applications. Material supplied with a kit shall not be considered as defective, even though not in exact accordance with specifications, if it substantially fulfills performance requirements. This warranty is not transferable and applies only to the original purchaser. This warranty is in lieu of all other warranties and the Heath Company neither assumes nor authorizes any other person to assume for them any other liability in connection with the sale of Heathkits.

The assembler is urged to follow the instructions exactly as provided. The Heath Company assumes no responsibility for the operation of the completed instrument, nor liability for any damages or injuries sustained in the assembly or operation of the device.

BIBLIOGRAPHY

Added information on the construction and use of A.C. Voltmeters will be found in many radio magazines. Particular reference is made to:

Vacuum Tube Voltmeters, 2nd edition..... by J. F. Rider

An Electronic A.C. Voltmeter..... by L. Fleming
Radio and Television News, Feb. 1951

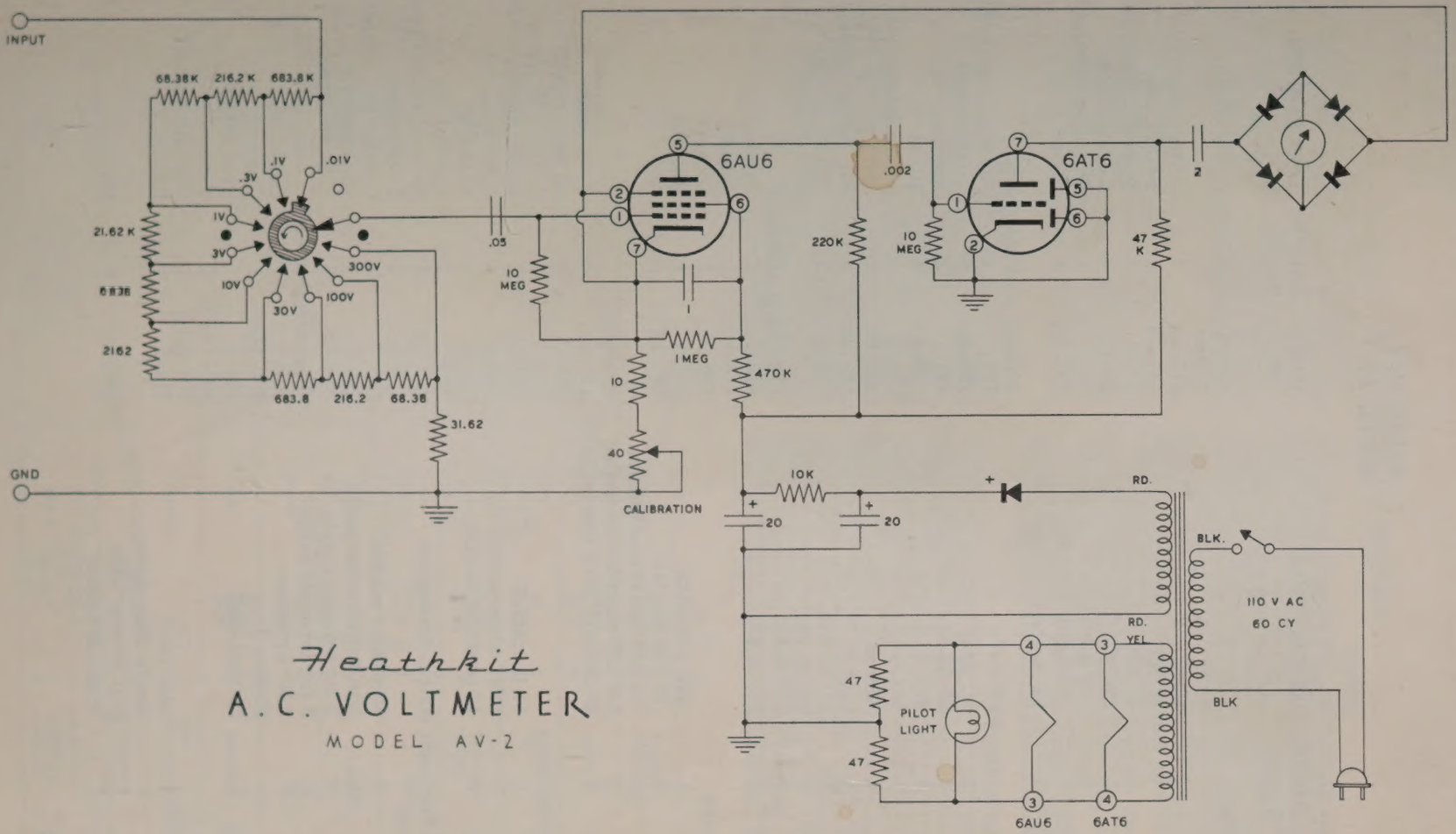
A Vacuum Tube Voltmeter for Audio Frequencies..... by H. C. Likel
Electronics, December, 1940

Vacuum Tube Voltmeter Using Feedback..... by S. Ballantine
Electronics, September 1938

Use of Decibels:

Practical Sound Engineering..... by H. M. Tremaine
Radio and Television News, May 1951

HEATH COMPANY
Benton Harbor, Michigan



Heathkit

A.C. VOLTMETER

MODEL AV-2

PARTS LIST
MODEL AV-2

PART No.	PARTS Per Kit	DESCRIPTION
Resistors		
1-41	1	10 Ω
1-1	2	47 Ω
1-20	1	10 KΩ
1-25	1	47 KΩ
1-29	1	220 KΩ
1-33	1	470 KΩ
1-35	1	1 megohm
1-40	2	10 megohm
Precision Resistors		
2-22	1	31.62 Ω
2-23	1	68.38 Ω
2-25	1	216.2 Ω
2-28	1	683.8 Ω
2-31	1	2162 Ω
2-33	1	6838 Ω
2-39	1	21.62 KΩ
2-40	1	68.38 KΩ
2-42	1	216.2 KΩ
2-45	1	683.8 KΩ
Condensers		
20-7	1	.002 μfd mica
23-10	1	.05 μfd tubular
23-20	1	1.0 μfd metallized tubular
23-17	1	2.0 μfd metallized tubular
25-7	1	20-20 μfd 150 V electrolytic
Controls-Switches		
11-16	1	40 Ω control
60-1	1	SPST slide switch
63-11	1	10 position switch
Sockets-Terminal strips-Grommets Feet-Knob		
434-15	2	Miniature socket
431-1	1	One lug terminal strip
431-2	2	2 lug terminal strip
431-3	1	3 lug terminal strip
73-1	2	3/8" grommet
261-1	4	Rubber feet
462-19	1	Skirted knob
Wire		
89-1	1	Line cord
340-2	1	length Bare wire
344-1	1	roll Hookup wire
346-1	1	length Spaghetti

PART No.	PARTS Per Kit	DESCRIPTION
Tubes-Transformer-Rectifiers Meter		
411-10	1	6AT6 tube
411-11	1	6AU6 tube
54-2	1	Power transformer
56-1	4	Crystal diode
57-1	1	Selenium rectifier
407-8A	1	Meter
Binding post assembly		
75-1	1	Binding post insulator
250-20	2	Thumbscrew
427-1	2	Binding post
252-5	2	10-32 nut
254-3	2	#10 lockwasher
253-6	2	#10 Fiber washer
253-8	2	#10 Nickel washer
259-3	2	#10 Solder lug
Pilot light assembly		
412-1	1	#47 Lamp
413-1	1	Jewel
434-22	1	Socket
455-1	1	Bushing
252-12	1	Nut
Hardware		
250-2	4	3-48 Screw
250-8	2	#6 Sheet metal screw
250-9	9	6-32 x 3/8" screw
250-19	2	10-24 Handle screw
252-1	4	3-48 Nut
252-3	9	6-32 Nut
252-7	2	Control nut
253-10	2	Control flat washer
254-1	9	Lockwasher
254-4	2	Control nut washer
259-1	2	#6 Solder lug
250-43	1	8-32 set screw
Sheet metal parts		
90-2	1	Case
200-M29	1	Chassis
203-4	1	Rear cover
203-19F20	1	Panel
204-M30	1	Chassis bracket
211-1	1	Handle
395-33	1	Manual

HELPFUL KIT BUILDING INFORMATION

Before attempting actual kit construction read the construction manual through thoroughly to familiarize yourself with the general procedure. Note the relative location of pictorials and pictorial inserts in respect to the progress of the assembly procedure outlined.

This information is offered primarily for the convenience of novice kit builders and will be of definite assistance to those lacking thorough knowledge of good construction practices. Even the advanced electronics enthusiast may benefit by a brief review of this material before proceeding with kit construction. In the majority of cases, failure to observe basic instruction fundamentals is responsible for inability to obtain desired level of performance.

RECOMMENDED TOOLS

The successful construction of Heathkits does not require the use of specialized equipment and only basic tools are required. A good quality electric soldering iron is essential. The preferred size would be a 100 watt iron with a small tip. The use of long nose pliers and diagonal or side cutting pliers is recommended. A small screw driver will prove adequate and several additional assorted screw drivers will be helpful. Be sure to obtain a good supply of rosin core type radio solder. Never use separate fluxes, paste or acid solder in electronic work.

ASSEMBLY

In the actual mechanical assembly of components to the chassis and panel, it is important that the procedure shown in the manual be carefully followed. Make sure that tube sockets are properly mounted in respect to keyway or pin numbering location. The same applies to transformer mountings so that the correct transformer color coded wires will be available at the proper chassis opening.

Make it a standard practice to use lock washers under all 6-32 and 8-32 nuts. The only exception being in the use of solder lugs—the necessary locking feature is already incorporated in the design of the solder lugs. A control lock washer should always be used between the control and the chassis to prevent undesirable rotation in the panel. To improve instrument appearance and to prevent possible panel marring use a control flat nickel washer under each control nut.

When installing binding posts that require the use of fiber insulating washers, it is good practice to slip the shoulder washer over the binding post mounting stud before installing the mounting stud in the panel hole provided. Next, install a flat fiber washer and a solder lug under the mounting nut. Be sure that the shoulder washer is properly centered in the panel to prevent possible shorting of the binding post.

WIRING

When following wiring procedure make the leads as short and direct as possible. In filament wiring requiring the use of a twisted pair of wires allow sufficient slack in the wiring that will permit the twisted pair to be pushed against the chassis as closely as possible thereby affording relative isolation from adjacent parts and wiring.

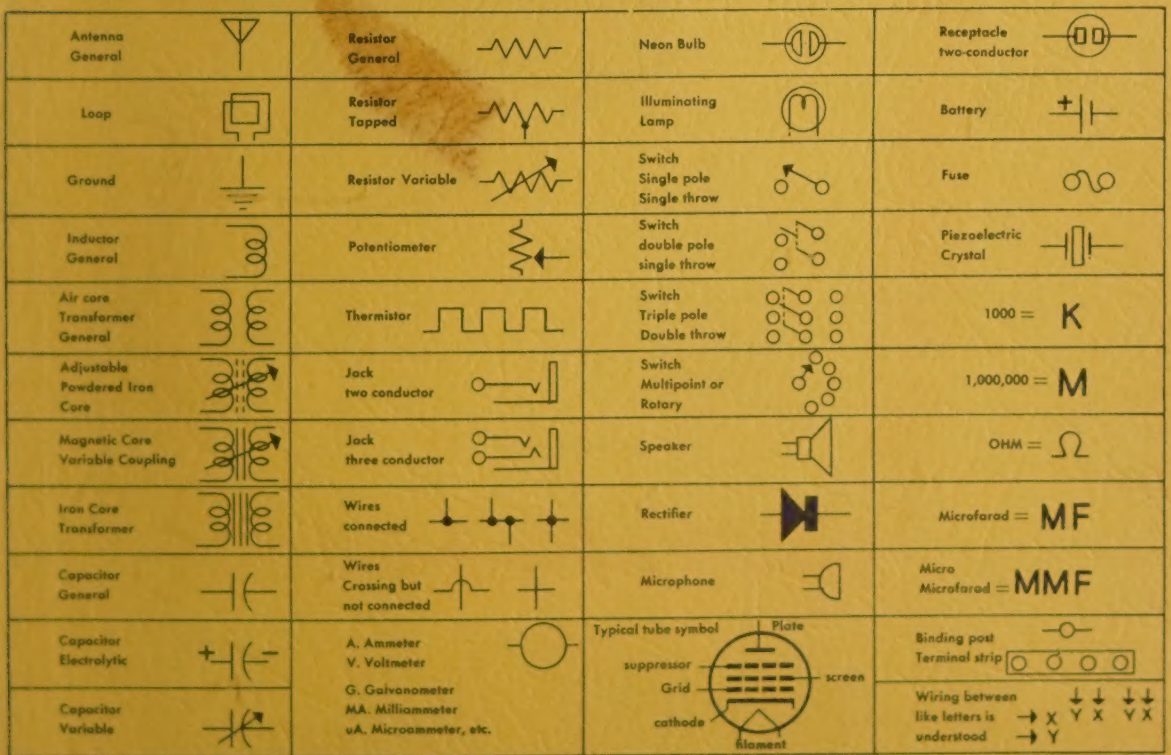
When removing insulation from the end of hookup wire, it is seldom necessary to expose more than a quarter inch of the wire. Excessive insulation removal may cause a short circuit condition in respect to nearby wiring or terminals. In some instances, transformer leads of solid copper will have a brown baked enamel coating. After the transformer leads have been trimmed to a suitable length, it is necessary to scrape the enamel coating in order to expose the bright copper wire before making a terminal or soldered connection.

In mounting parts such as resistors or condensers, trim off all excess lead lengths so that the parts may be installed in a direct point-to-point manner. When necessary use spaghetti or insulated sleeving over exposed wires that might short to nearby wiring.

It is urgently recommended that the wiring dress and parts layout as shown in the construction manual be faithfully followed. In every instance, the desirability of this arrangement was carefully determined through the construction of a series of laboratory models.

SOLDERING

Much of the performance of the kit instrument, particularly in respect to accuracy and stability, depends upon the degree of workmanship used in making soldered connections. Proper soldered connections are not at all difficult to make but it would be advisable to observe a few precautions. First of all before a connection is to be soldered, the connection itself should be clean and mechanically strong. Do not depend on solder alone to hold a connection together. The tip of the soldering iron should be bright, clean and free of excess solder. Use enough heat to thoroughly flow the solder smoothly into the joint. Avoid excessive use of solder and do not allow a flux flooding condition to occur which could conceivably cause a leakage path between adjacent terminals on switch assemblies and tube sockets. This is particularly important in instruments such as the VTVM, oscilloscope and generator kits. Excessive heat will also burn or damage the insulating material used in the manufacture of switch assemblies. Be sure to use only good quality rosin core radio type solder.



Courtesy of I. R. E.

HEATH COMPANY

A Subsidiary of Daystrom Inc.

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

BENTON HARBOR, MICHIGAN

MP MASTER
MA22849

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5/15/56